San Francisco Area Network of National Parks
Inventory and Monitoring Program

Dates: March 19-20, 2003

Location: Golden Gate Club, Presidio, San Francisco

Justification:
The National Park Service mission is to preserve and protect natural and cultural resources. Specific management goals relevant to this mission include:

- Determine status and trends in selected indicators of the condition of park ecosystems to allow managers to make better-informed decisions and to work more effectively with other agencies and individuals for the benefit of park resources.
- Provide early warning of abnormal conditions of selected resources to help develop effective mitigation measures and reduce costs of management.
- Provide data to better understand the dynamic nature and condition of park ecosystems and to provide reference points for comparisons with other, altered environments.
- Provide data to meet certain legal and Congressional mandates related to natural resource protection and visitor enjoyment.
- Provide a means of measuring progress towards performance goals.

An effective long-term ecosystem monitoring program will:

- Enable managers to make better informed management decisions;
- Provide early warning of abnormal conditions in time to develop effective mitigation measures;
- Provide data to convince other agencies and individuals to make decisions benefiting parks;
- Satisfy certain legal mandates; and
- Provide reference data for comparison with more disturbed sites.

Conceptual models:
A conceptual model is a comprehensive representation of key linkages and drivers of an ecosystem. It is a pictorial and verbal way of expressing how physical, chemical and biological elements of a system interact and how they are linked. The conceptual models presented here are largely designed to provide a road map for implementing a monitoring plan and will be modified in an interactive process, as the ecological linkages are better understood after several years of monitoring.

These models serve to:

- Conceptualize the function and structure of the resource realms and the ecosystems in a holistic manner, across multiple temporal and spatial scales.
- Identify major stressors and disturbance processes (both natural and anthropogenic).
- Identify resource attributes of concern and depict their inherent connectivity.

A conceptual model must take into account different scales of time and space, and many levels within a region including landscapes, communities and populations. The selection of "vital signs" as measures of ecological condition can include many approaches such as biodiversity, energy flux, or population dynamics. Measures of population dynamics include abundance, distribution, age structure, reproduction and recruitment, growth rates and mortality rates.

The steps required to develop a conceptual model include:

- Define the boundaries of the study area (in this case the San Francisco Area Network of National Parks),
- Identify the key ecosystem components and stressors or drivers, and
- Identify the priority elements to monitor.

Models:

Figure 1. Generalized schematic of the biome within which the parks occur.

Figure 2. Generalized model depicting the relationships of the primary natural ecosystem processes and drivers, anthropogenic stressors and socio-political forces, and their effects on the resource realms of the three dominant ecosystems of the parks.

Figures 3a-b. Conceptual model of the spatial scales within which the monitoring might occur.

Figures 4a-c. Ecosystem conceptual model for each of the dominant ecosystems of the parks. Includes more specific information on 1) the natural resource drivers and anthropogenic stressors, 2) the effects on the ecosystem, and 3) general indicators within each resource realm.

Figure 5. An example of an indicator model that will be developed in the final Monitoring Plan.

Definitions:

Resource realms: Four major resource realms— biosphere, hydrosphere, atmosphere, and lithosphere—were used to conceptualize broad categories of interrelated ecosystem processes and components.

Ecosystems: Three main ecosystems were identified for the network of parks; terrestrial, wetland and marine. Within each ecosystem are sub-categories or forms. Marine forms includes ocean, sandy beach, rocky intertidal, bay/estuary; wetland forms includes running water, standing water and ground water; and terrestrial forms includes grassland, shrubland, woodland and distinct landforms (e.g., serpentine).

Natural ecosystem processes and drivers: Drivers are major external driving forces such as climate, fire cycles, biological invasions, hydrologic cycles and natural disturbance events (e.g., earthquakes, droughts and floods) that have large scale influences. Process examples include succession, deposition/accretion of soils, and marine currents.

Anthropogenic stressors: Physical, chemical or biological perturbations to a system that are either a) foreign to that system or b) natural to the system but applied at an excessive (or deficient) level. Stressors cause significant changes in the ecological components, patterns and processes in natural systems. Examples include resource extraction, air quality degradation, land use changes, water quality degradation, water quantity alteration, human population increase or behavioral change, invasive species introductions, and fire regime alteration.

Socio-political forces: Laws, mandates, economic pressures and environmental perception influence political decisions bear upon anthropogenic stressors, and thereby, have a cascading effect on ecosystem function. These can include environmental laws (ESA, CWA, etc.), budgets, and changing social values.

Ecological effects: Are the physical, chemical and biological responses to drivers and stressors.

Indicators: Also called "vital signs" or attributes, are any measurable feature of the environment that provides insights into changes in the state of the ecosystem. Indicators are intended to track changes in a subset of park resources and processes that are determined to be the most significant indicators of ecological condition of those specific resources that are of greatest concern to the parks. Indicators may occur at any level of organization including landscape, community, population or genetic levels, and may be compositional (referring to the variety of elements in the system), structural (referring to the organization or pattern of the system), or functional (referring to ecological processes).

Figure 1. Conceptual model illustrating the ecological subsystems present in the San Francisco Bay Area Network parks (from Jenkins et al. 2002).

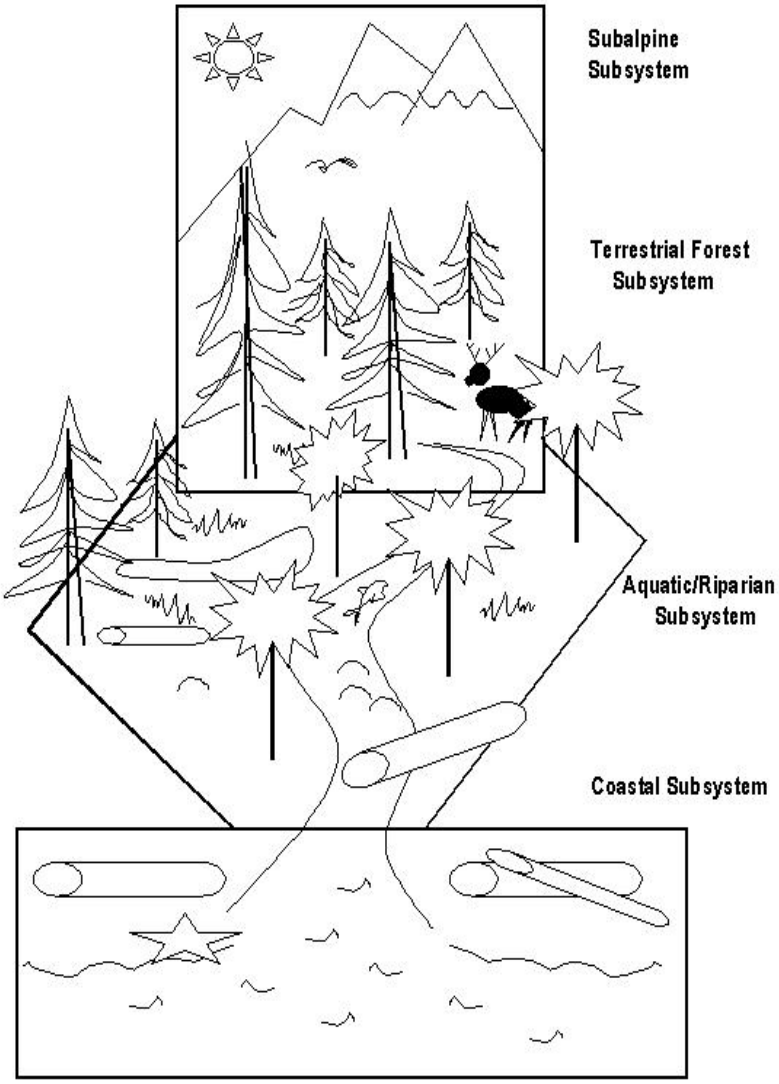


Figure 2: Generalized Conceptual Model

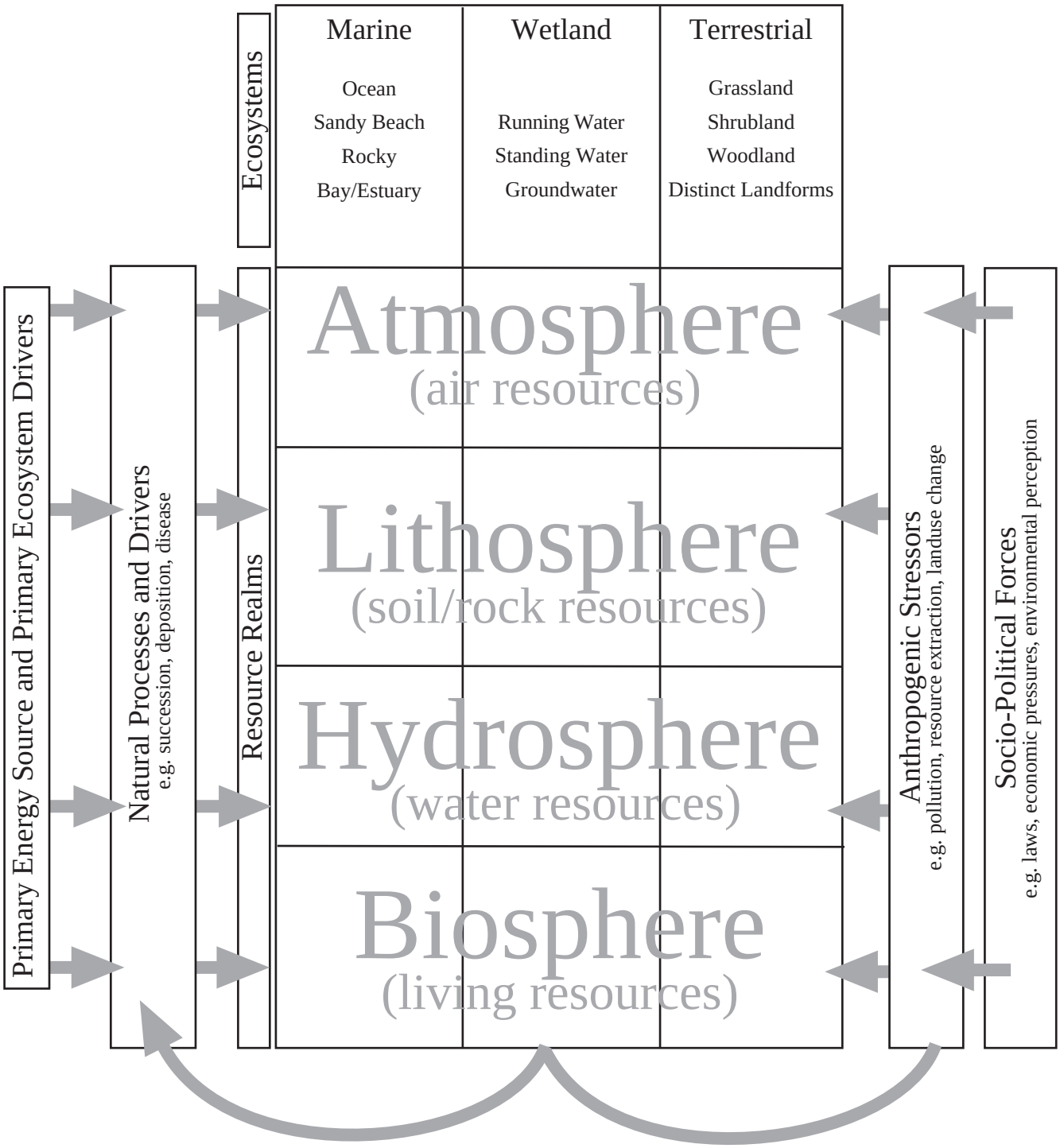
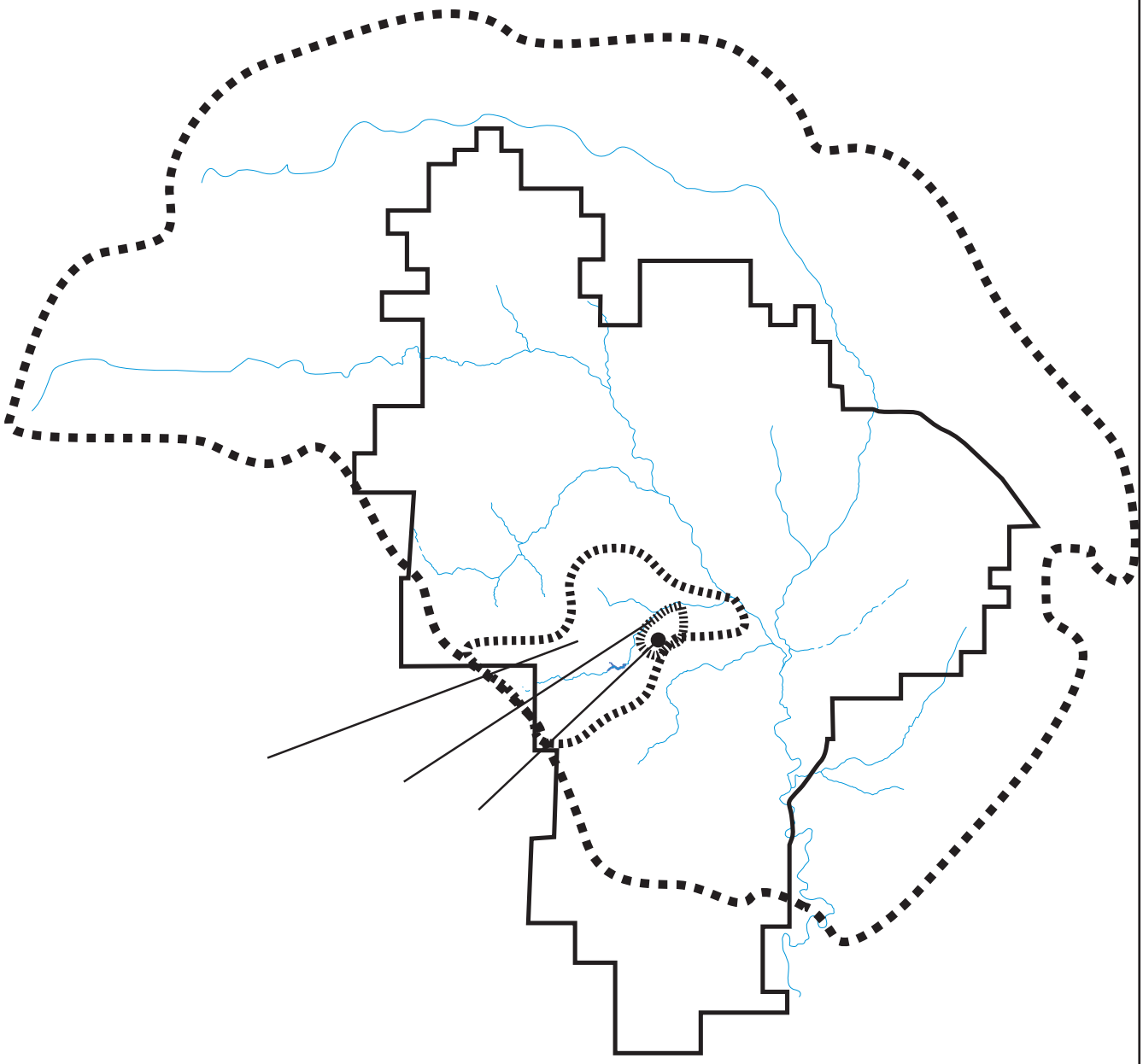


Figure 3a: Conceptual Model Scales



Scale	Name	Size	Scale Synonyms	Examples
I	Habitat	20 m	Patch	pheobe nest territory
II	Community	200 m	Vegetation type	chamise chaparral unit
III	Sub Watershed	5 km	Landform	Bear Gulch drainage
IV	Watershed	20 km	Park Boundary, aquifer	Chalone Creek
V	San Benito Co	50 km	Mountain range	SCoRI floristic subregion
VI	Cen Coast Ranges	100 km	Region, ecoregion	Salinas river, Salinian Block
VII	Coast Ranges	500 km	Csa climate type	Mediterranean- mild winter
VIII	California	1000 km	Floristic provnce	California
IX	Western Province	2000 km	Pacific cordilliara	subduction geology controlled
X	Global	20000 km	Planetary	Earth

Figure 3b: Conceptual Model Scales continued

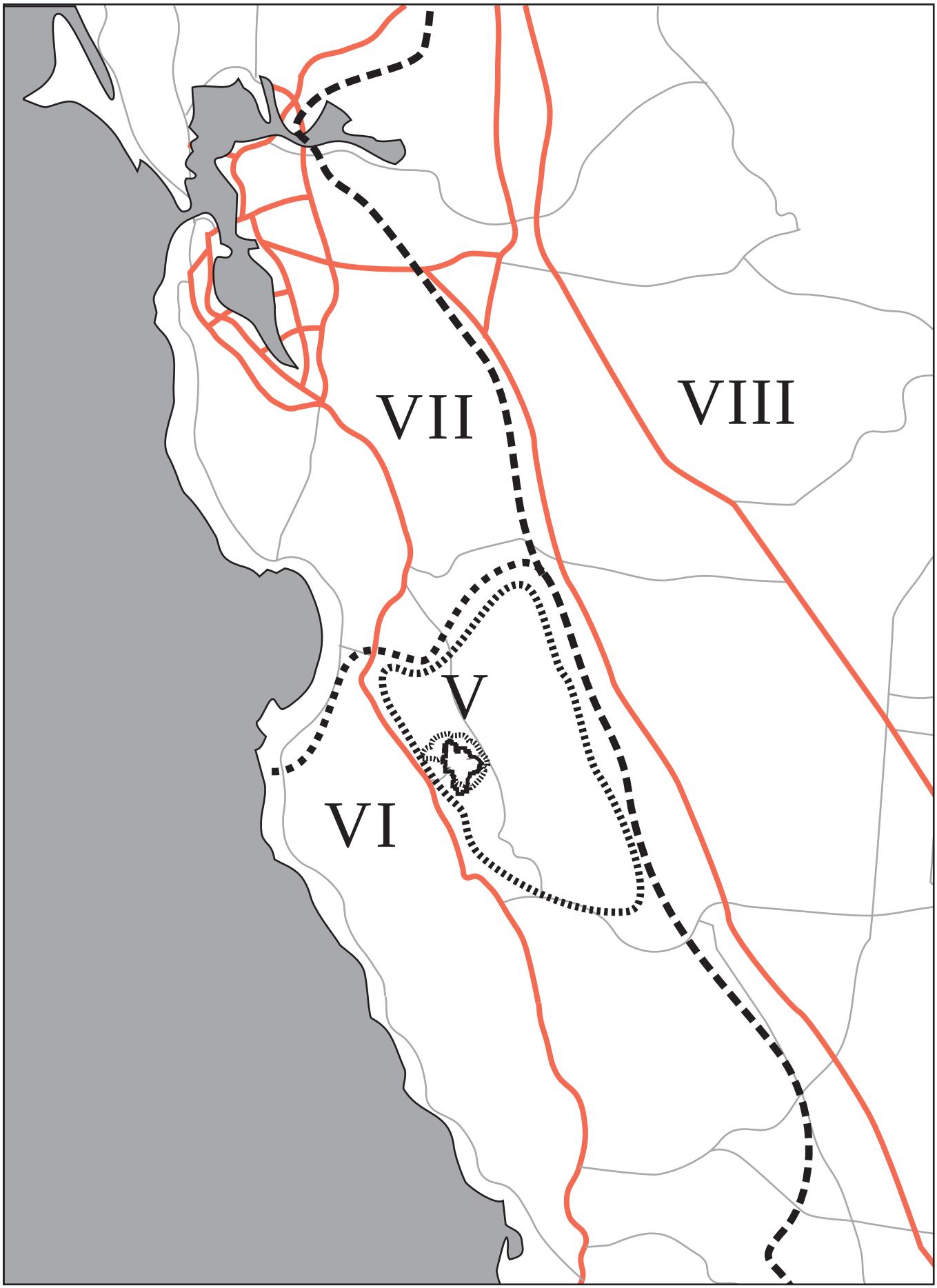


Figure 4a: Ecosystem Conceptual Model for Marine Ecosystems

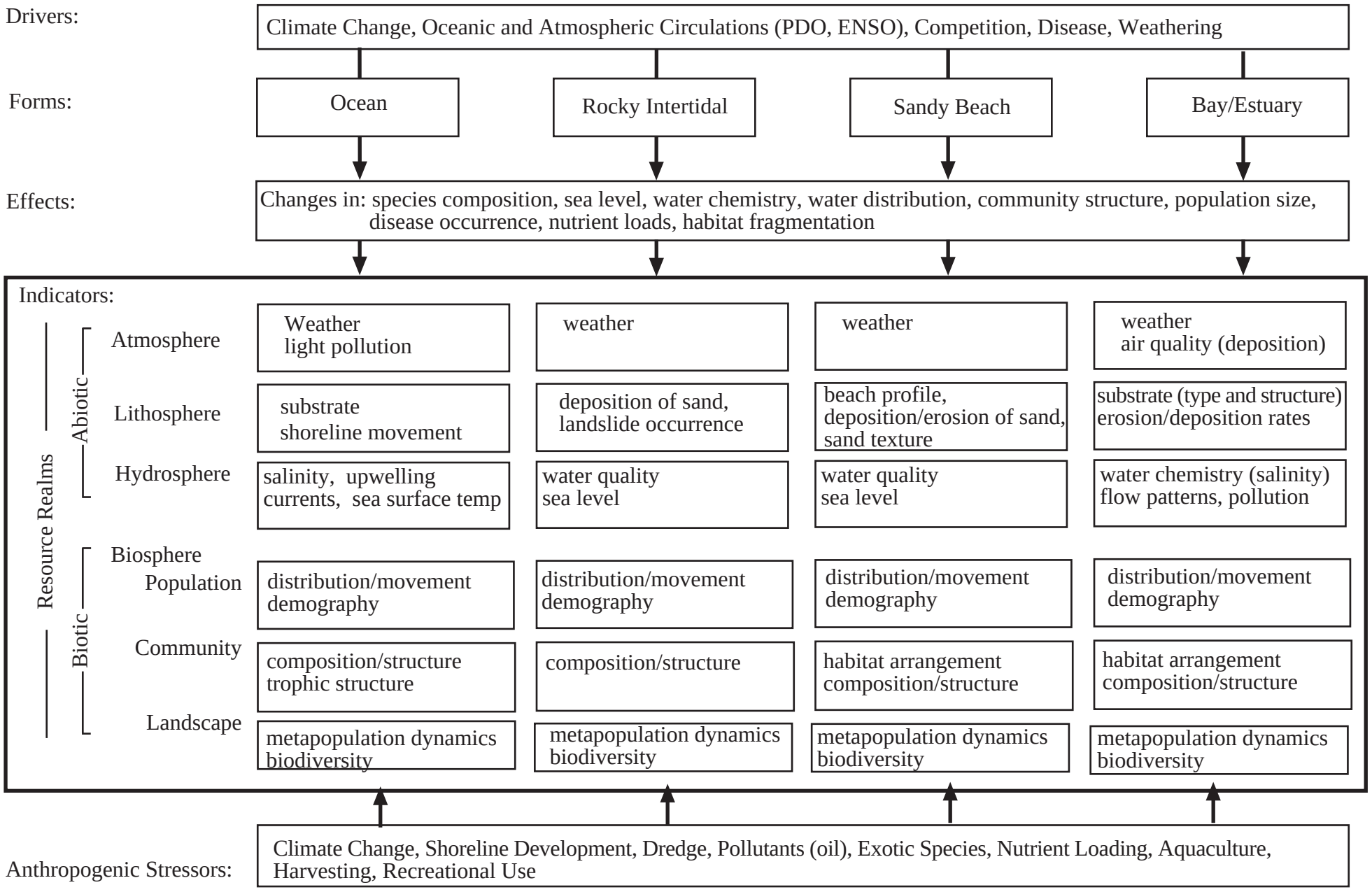


Figure 4b: Ecosystem Conceptual Model for Aquatic/Wetland Ecosystems

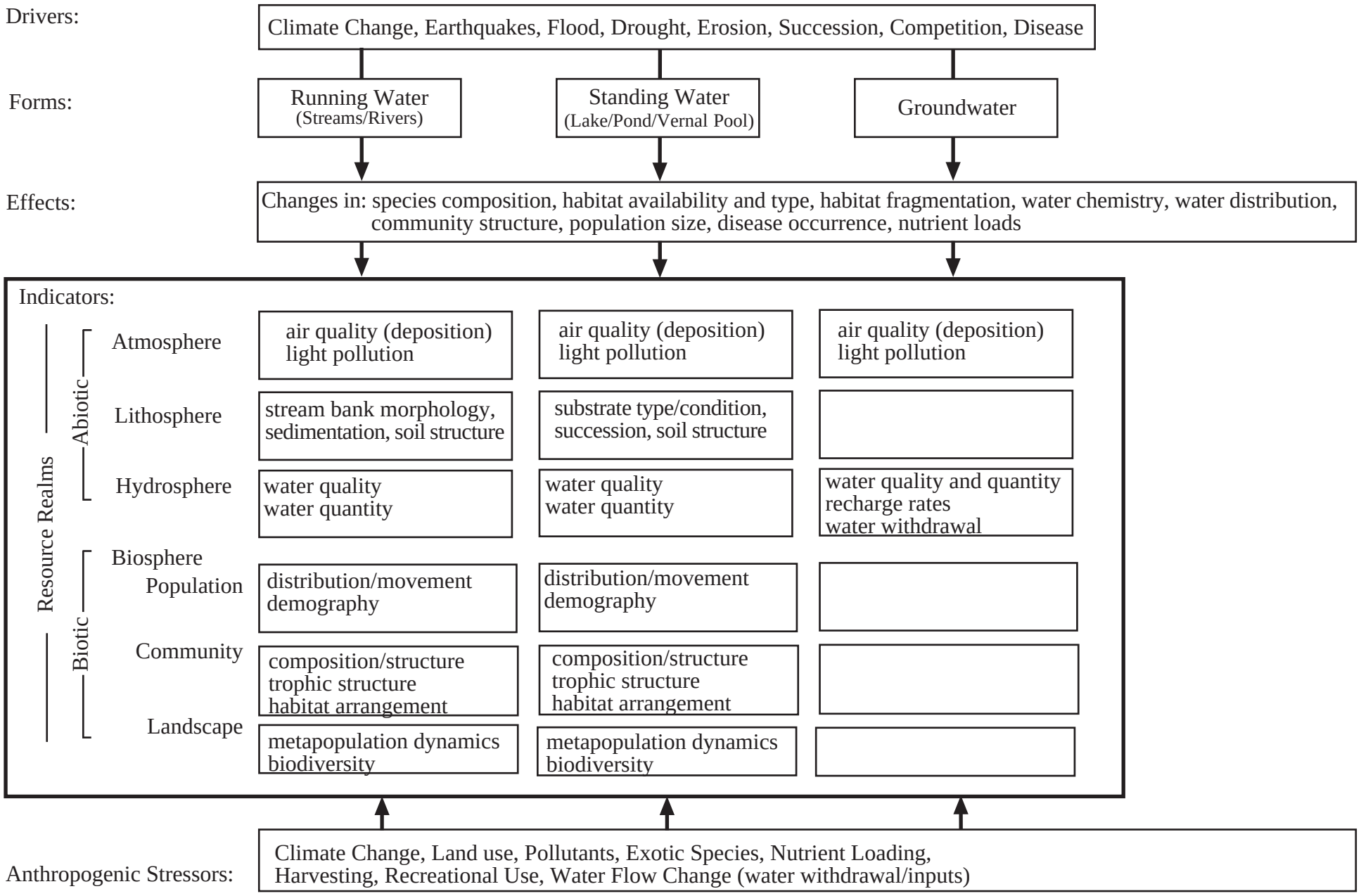


Figure 4c: Ecosystem Conceptual Model for Terrestrial Ecosystems

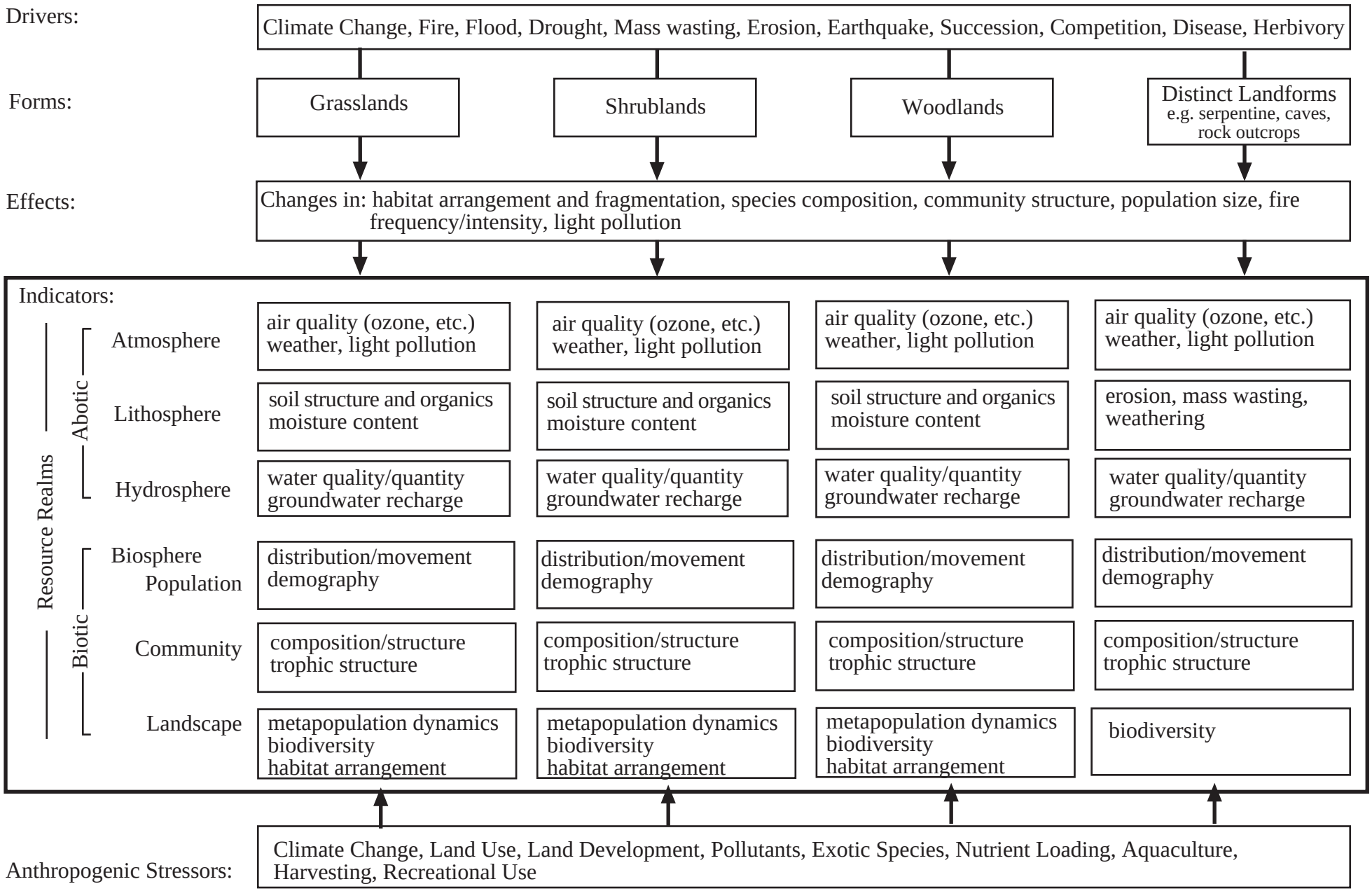
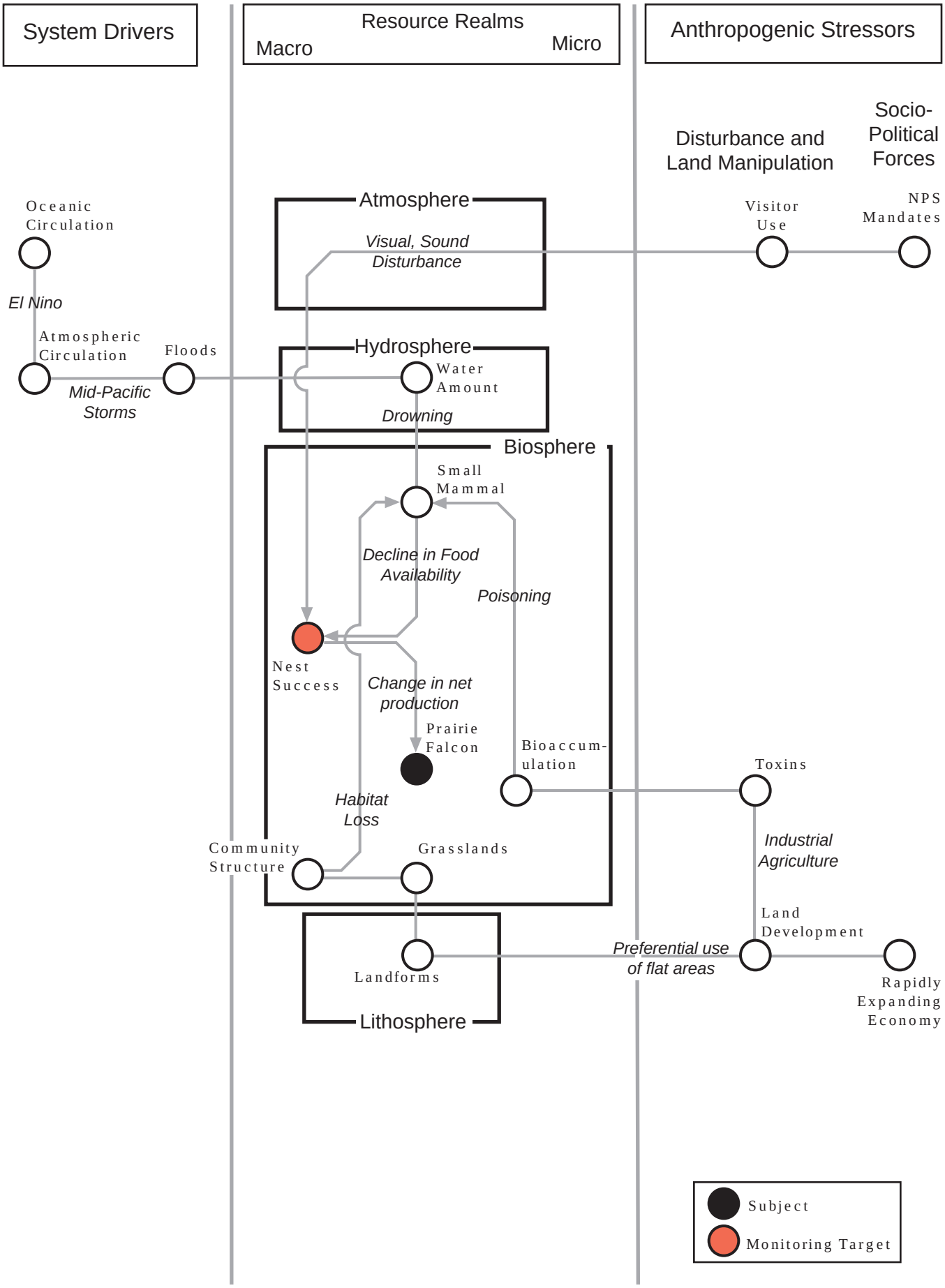



Figure 5: Example of Indicator Conceptual Model